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## FORECASTING JUVENILE OFFENDER POPULATIONS

*"The best prophet of the future is the past"- Chinese Proverb*

by Fang Qian, Lynette Greenfield, and Susan Nicely

### INTRODUCTION

Does Virginia need to build a new juvenile correctional center (JCC)? To close one? These questions can be answered using a juvenile offender population forecast. Imagine if decision makers and correctional administrators sat around a large conference table and determined how many correctional beds, programs, and services would be needed for the next ten years based solely on intuition and experience. While both are valuable, taken alone the accuracy of any such predictions would be questionable at best. Now consider objective historical trends to be that same experience, and statistical assumptions to be the intuition, combined in a complex mathematical model. The result is a more reliable and accurate tool that decision makers and administrators can use as they consider future secure bed space needs for juveniles committed to the state.

Presented in this report is a description of forecast methodology, the simulation model developed by the Virginia Department of Juvenile Justice (DJJ), key assumptions upon which the model was generated, as well as the FY2006-FY2011 forecast results and an accuracy report for Virginia's state responsible (SR) juvenile population.

### WHY FORECAST?

Forecasting the size of juvenile populations in correctional facilities provides helpful information for budgeting and planning of operational expenditures and provides data for assessing policy needs. Accuracy of these projections can impact the success of planning and resource allocation. The process used by DJJ to generate, monitor, and modify the forecast contributes to credible projections and more effective policies. In Virginia, the Secretary of Public Safety oversees the forecast process and, as required by the Appropriation Act (Item 377(A) of Chapter 3 of the 2006 Acts of Assembly (Special Session I)), presents updated offender population (state and locally responsible adults as well as juveniles) forecasts annually to the Governor, the Chairmen of the House Appropriation and Senate Finance Committees, and the Chairmen of the House and Senate Courts of Justice Committees.

### FORECASTING METHODS

There are four major forecasting methods for projecting correctional center populations:

1. Microsimulation models project the movement of individuals through the justice system using individual-level data.
2. Disaggregated flow models perform forecasts based on the movements of groups through correctional systems. The simulation model developed by DJJ falls into this category.
3. Statistical models, such as time-series (e.g., Autoregressive Integrated Moving Average - ARIMA) or regression analysis, generate forecasts based on the historical trends of juvenile justice variables.
4. Mathematical models project populations by adding a constant amount or multiplying by a constant growth rate.

Of the four methods, microsimulation models provide the greatest flexibility and power in projecting population. However, these models require a micro-level database of individual offenders and few juvenile justice agencies have the data necessary to support this approach. The next ranked model in order of flexibility is the disaggregated flow model, followed by statistical and mathematical models.

One of the most important features of a simulation model is that it captures more factors impacting a population than a time series model. A time series model is based on historical data and cannot be adjusted once the model is selected. This model assumes the future will reflect the past and therefore has little mechanism to account for change. A simulation model, however, can generate more explanatory and flexible projections due to its ability to integrate system changes into the model process, taking all dynamic factors into account. For example, if admissions decrease while length of stay (LOS) increases, the model will consider both factors. The model's output exhibits future population projections based on various

adjustments, which could be helpful in assessing the impact of possible changes to the population. This makes the simulation model a valuable tool for data-driven management.

## DJJ's SIMULATION MODEL

DJJ's simulation model was designed to forecast the monthly average daily population (ADP) of SR juveniles for the next six years. The simulation software currently used is Simul8®. The flowchart (Figure 1) illustrates the system reflected in DJJ's simulation model.

One of the most challenging aspects of the simulation model is to determine new admission inputs. To forecast the population in a given period with a simulation model, a historical admission stream is forecasted for that period, in this case 72 months (6 years). In general, the admission forecast is produced using time series forecast techniques based on historical data. New admissions projected for each month are distributed among three categories: determinate, indeterminate, and sex offenders. The indeterminate category is subdivided according to Virginia's LOS policy which reflects offense severity

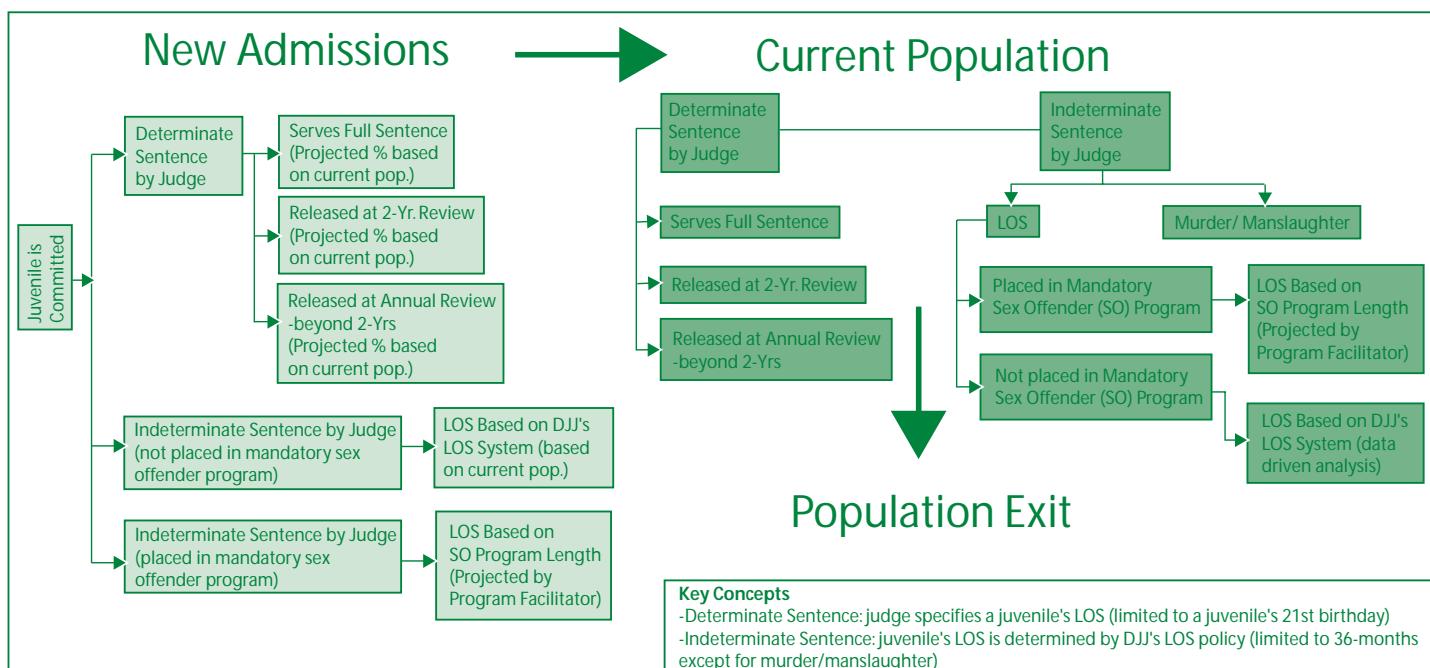
categories. Juveniles are exited from the model using a weighted sum of release rates across all subgroups. For example, subgroups with a greater number of admissions will be weighted more heavily in the release calculation.

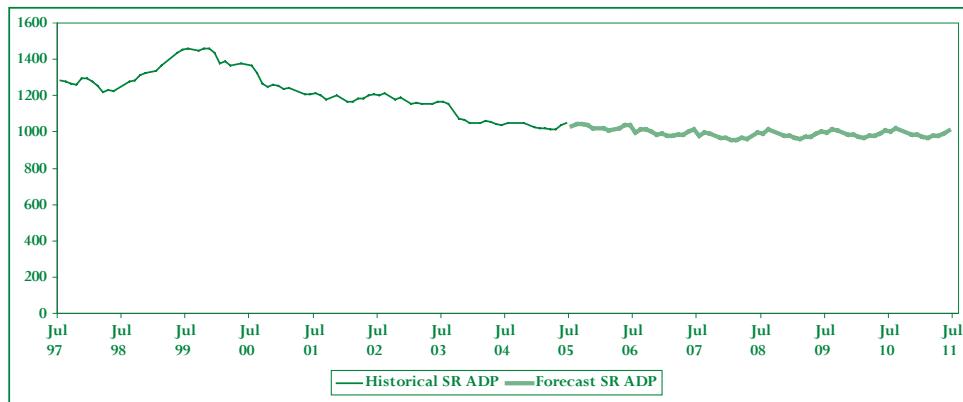
There are a number of key assumptions that are part of DJJ's simulation model:

- The distribution of monthly admissions into the three major categories/subgroups does not change during the forecast horizon. For example, 7% of admissions will fall into the sex offender category and that percentage is used for each month projected in the forecast.
- DJJ's LOS policy will not change during the forecast horizon.
- Each admissions subgroup has its own release rate.

In addition to an admission forecast, the model includes juveniles currently incarcerated, aka the "stock" population. Juveniles in the "stock" population are released based on historical release rates for a particular month. For example, in July 2007 release rates will be examined using the

**FIGURE 1: JUVENILE MOVEMENT WITHIN THE SIMULATION MODEL**



**FIGURE 2: HISTORICAL AND PROJECTED STATE RESPONSIBLE JUVENILE POPULATION**

average of the release rates from July 2005 and July 2006.

The model sums up the juveniles remaining after releases from both “stock” population and new admissions, to provide an ADP for that month. The simulation model will keep those admitted in a certain month separate from the “stock” population throughout the forecast horizon.

In July 2005, DJJ forecasted the SR Juvenile Population for FY2006-2011 using the simulation model. The simulation model generated the SR Population forecast for the targeted time period (Figure 2). The forecast numbers predict that the SR Population will remain stable at around 1000 juveniles for the next 6 fiscal years.

#### FORECASTING PROCESS

Many states and local agencies project juvenile populations to identify future demand for confinement space and program resources. For example, West Virginia<sup>1</sup> forecasts the juvenile correctional population using Wizard 2000 projection software to simulate actual case flow through the system; Oregon<sup>2</sup> Youth Authority forecasts Close Custody Demand of Youth using models developed by Oregon’s Office of Economic Analysis; Texas<sup>3</sup> forecasts its juvenile correctional population by modeling offender group movements through the justice system while making assumptions about flow rates between

stages (e.g., referral, commitment, release) for different subgroups (e.g., types of offenders); a Maryland study<sup>4</sup> projects the ADP of out-of-home placements (including post-dispositional placements and detention) using a mathematical forecasting model; Colorado<sup>5</sup> forecasts juvenile commitments and parole population using a time-series analysis by the Yule-Walker model found to best fit their historical monthly ADP; and, Washington<sup>6</sup> forecasts the Juvenile Rehabilitation Administration residential population composed of regular admissions, parole revocations, and adult offenders.

In Virginia, the forecasting process uses three committees to produce the official forecast (See Figure 3):

1 Forecasters from DJJ and the Department of Planning and Budget (DPB) independently develop forecast models and present them to the Technical Advisory Committee. This committee reviews the forecast accuracy report for the previous fiscal year, reviews the merits of both models, and makes a final selection of which forecast to recommend to the Policy-Technical Liaison Committee.

2 The Policy-Technical Liaison Committee provides guidance and oversight to the Technical Advisory Committee on forecast development. After scrutinizing each forecast, this liaison committee makes recommendations to the Policy Advisory Committee.

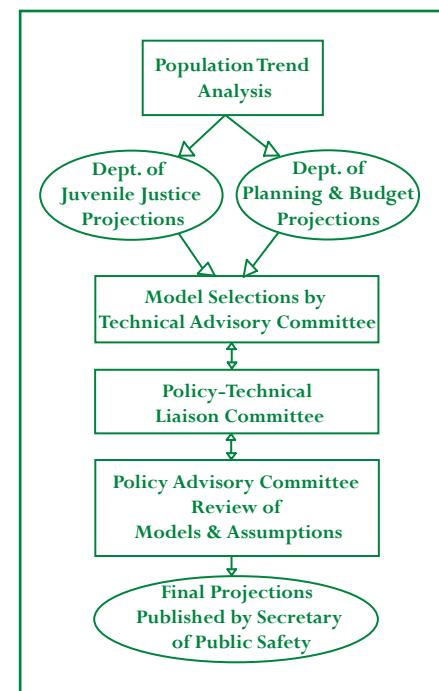
- 3 The Policy Advisory Committee reviews the recommended forecast and determines the official forecast. This committee also makes any necessary adjustments to the forecast after considering emerging trends, recent policy changes, or new legislation. Members include agency heads, juvenile and circuit court judges, and staff from the General Assembly’s House Appropriations and Senate Finance Committee.

The SR juvenile population forecast is one of the most important population forecasts projected each fiscal year. This forecast process brings about more understanding of juvenile offender population trends and allows decision makers to take a more active role in generating assumptions about the SR juvenile population.

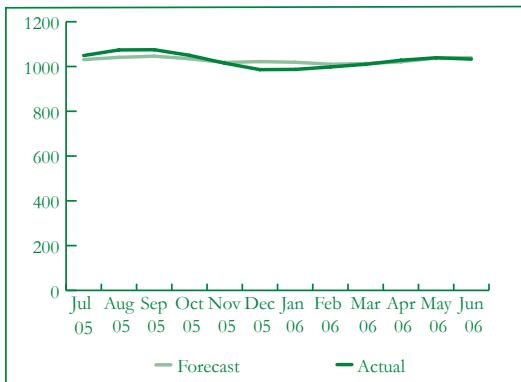
#### FACTORS IMPACTING THE FORECAST

Many factors can influence the SR juvenile offender population forecasts, including JCC admissions, releases, LOS, and legislative changes.

- *New Admissions to JCCs:* The simulation model needs an input data stream of new admissions in order to project ADP. The admission data stream can

**FIGURE 3: FORECAST PROCESS**

**FIGURE 4: FORECAST ACCURACY, FY2006**



be either historical data or generated by a statistical model. The Technical Advisory Committee will review the historical admissions data and choose the appropriate methodology. The accuracy of the forecasted admission stream will significantly impact overall accuracy of the simulation model.

- Changes in LOS Policies:** The LOS policy is the backbone of the simulation model. Any changes to release practices must be incorporated into the model for it to be accurate. For example: if the DJJ Board changed the LOS policy so that all juveniles with a 3-6 month LOS would stay a minimum of 6-months, this would increase ADP and be an essential component to factor into the model. Therefore, it is important for analysts to work closely with staff responsible for determining if current LOS practices will continue.
- JCC Releases:** Before running the simulation model, the release rate is calculated individually from historical data for the stock population and new admissions by the categories of indeterminate, determinate, and sex offenders (See Figure 1). If the actual release rates differ significantly from the rates used in the model, the forecast will be inaccurate.

- Legislative Changes:** Changes in the *Code of Virginia* need to be incorporated into the model. For example, in July 2000 the minimum offense criteria for

commitment to DJJ increased from one Class 1 misdemeanor with a prior guilty adjudication for at least one felony or *one* misdemeanor, to one Class 1 misdemeanor with a prior guilty adjudication for at least one felony or *three* Class 1 misdemeanors. This legislative change caused a decrease in DJJ admissions beginning in FY2001.

### FORECAST ACCURACY

On a monthly basis, DJJ compares the projected number with the actual population for forecast accuracy purposes and reports to the Virginia Secretary of Public Safety quarterly. Figure 4 shows accuracy results for the population forecast generated by the simulation model in FY2005. The overall accuracy between the actual population and the forecast is 16 juveniles per month (1.6%) for FY2006. To determine the cause of any discrepancies, an analysis of the factors impacting the forecast is conducted. The FY2005 simulation model generated a reliable forecast due to its accurate assumptions on admissions, releases, and LOS.

### SIMULATION MODEL USES

In the data-driven decision making environment that exists at DJJ, an accurate forecast is utilized in numerous arenas such as population management. An example of the importance of the forecast is the crucial role it played in determining the use of the Department's resources. In conjunction with other data, the forecast's prediction of a relatively stable population trend allowed DJJ to not only consider but to enact the closure of a facility and redistribution of its population and staff.

The simulation model can also be used to project the relative effect of policy changes based upon current information. Being a dynamic system, the simulation model allows DJJ to evaluate both short and long term impacts of prospective policy and legislative changes. It can simulate the scenarios for policy change and answer the "what if" questions. For example, how will the population change if a policy alteration

increases LOS for certain offenses? Holding admissions constant, release rates and LOS for the simulation input will change and the model output will demonstrate the possible prediction for future populations. The model can assist policy makers in making informed decisions on policy changes, such as LOS category adjustments, opening/closing facilities, and legislative changes.

### CONCLUSION

The State Responsible Juvenile Offender Population Forecast is an important tool for policy makers and the public to predict future population trends. DJJ found that the simulation model is one of the most flexible and useful models for population forecast. It is not only a forecast tool, but also a great assessment instrument for policy makers. Forecasting is never an exact science, but using a sophisticated model allows a more accurate glimpse into the future.

<sup>1</sup> Division of Criminal Justice Services. (2003). *Juvenile Corrections Forecast 2002 - 2013: A Study of the State's Juvenile Corrections Population*. Charleston, WV.

<sup>2</sup> Office of Economic Analysis. (2004). *Oregon Youth Authority Close Custody Demand Forecast: Biennial Review of Methodology*. Salem, OR: Oregon Department of Administrative Services.

<sup>3</sup> Mears, Daniel P. (2002). *Forecasting Juvenile Correctional Populations in Texas*. Washington, DC: Urban Institute.

<sup>4</sup> Development Services Group, Inc. (2004). Ch. 10 Forecast and Residential Resource Needs. In *Consulting Services to Develop a Facilities Master Plan Phase 1: Gap Analysis Report* (pp. 10-1-10-20). Baltimore: Maryland Department of Juvenile Services.

<sup>5</sup> Office of Research and Statistics (2005). *Juvenile Commitment and Parole Population Projections*. Denver: Colorado Division of Criminal Justice.

<sup>6</sup> Steiger, John C. (2005). *JRA Forecast Model*. Olympia, WA: Caseload Forecast Council.